

### REMARKS

The Examiner's careful review and examination of the subject application are noted and appreciated.

The present invention relates to a hydrogen storage material comprising a hydrogen storage alloy having the formula  $Ti_{Q-X}Zr_XMn_{Z-Y-W}A_YCr_W$ , wherein A is one or more elements selected from the group consisting of V, Fe, Ni, and Al,  $0.9 \leq Q \leq 1.1$ ,  $0.05 \leq X \leq 0.35$ ,  $0.32 \leq Y \leq 1.8$ ,  $1.8 \leq Z \leq 2.1$ ,  $0.0 \leq W \leq 0.34$ , and  $2.85 \leq Q + Z \leq 3.05$ .

Applicants have carefully reviewed the above-identified Office Action. Applicants contend that, in view of the clarifying remarks set forth herein, all bases of objection and rejection have been overcome. Accordingly, Applicants respectfully request withdrawal of the pending rejections and allowance of the claims submitted.

### SUPPORT FOR CLAIM AMENDMENTS

Support for amendment to the claims can be found in, for example, page 8 of the specification as originally filed. As such, no new matter has been added.

### CLAIM REJECTIONS UNDER 35 U.S.C. §102

For the reasons which follow hereinafter, the rejection of claims 1, 2, 5-8, and 23 under 35 U.S.C. §102 as being anticipated by Bernauer et al. or "Compilation of IEA/DOE/SNL Hydride

Databases" has been obviated by appropriate amendment and should be withdrawn.

Bernauer et al. and the "Compilation of IEA/DOE/SNL Hydride Databases" disclose a hydrogen storage alloy having the composition  $\text{Ti}_{0.98}\text{Zr}_{0.02}\text{V}_{0.43}\text{Fe}_{0.09}\text{Cr}_{0.05}\text{Mn}_{1.5}$ .

In contrast, the presently pending invention claims a hydrogen storage alloy having the formula  $\text{Ti}_{Q-X}\text{Zr}_X\text{Mn}_{Z-Y-W}\text{A}_Y\text{Cr}_W$ , wherein A is one or more elements selected from the group consisting of V, Fe, Ni, and Al,  $0.9 \leq Q \leq 1.1$ ,  $0.05 \leq X \leq 0.35$ ,  $0.32 \leq Y \leq 1.8$ ,  $1.8 \leq Z \leq 2.1$ ,  $0.0 \leq W \leq 0.34$ , and  $2.85 \leq Q + Z \leq 3.05$ . Bernauer et al. and the "Compilation of IEA/DOE/SNL Hydride Databases" do not disclose a hydrogen storage alloy having a limit whereby  $2.85 \leq Q + Z \leq 3.05$  as presently claimed. In particular, Bernauer et al. and the "Compilation of IEA/DOE/SNL Hydride Databases" disclose an alloy when put into the format of the present invention having a limit of  $Q + Z = 3.07$ , not a limit of  $2.85 \leq Q + Z \leq 3.05$  as presently claimed. As such, the presently pending invention is readily distinguishable and clearly patentable over the cited reference and the rejection should be withdrawn.

For the reasons which follow hereinafter, the rejection of claims 1-4, 7, 8, and 23 under 35 U.S.C. §102 as being anticipated by Nakamura et al. ('690) has been obviated by appropriate amendment and should be withdrawn.

Nakamura et al. discloses a hydrogen storage alloy having a composition of  $Ti_{1-x-z}\alpha_zY_xMn_{y-w}\beta_w$  (see col. 6, lines 44-49). Nakamura also discloses hydrogen storage alloys having the composition  $Ti_{0.9}Zr_{0.1}Mn_{1.7}V_{0.3}$  and  $TiMn_{1.6}V_{0.3}Al_{0.1}$  (see examples 11, 12).

In contrast, the presently pending invention claims a hydrogen storage alloy having the formula  $Ti_{Q-X}Zr_XMn_{Z-Y-W}A_YCr_W$ , wherein A is one or more elements selected from the group consisting of V, Fe, Ni, and Al,  $0.9 \leq Q \leq 1.1$ ,  $0.05 \leq X \leq 0.35$ ,  $0.32 \leq Y \leq 1.8$ ,  $1.8 \leq Z \leq 2.1$ ,  $0.0 \leq W \leq 0.34$ , and  $2.85 \leq Q + Z \leq 3.05$ . Nakamura et al. do not disclose an alloy as presently claimed. In particular Nakumara et al. discloses a hydrogen storage alloy including yttrium, whereas the present invention does not include yttrium and excludes its use with the "consisting essentially of" language. The alloys disclosed in examples 11 and 12 do not fall within the limits of the alloys as presently claimed. The alloy in example 11 when put into the formula of the present invention has a y value of .3 which falls out of the range presently claimed. The alloy in example 12 does not include zirconium, which is included in the hydrogen storage alloy presently claimed. As such, the presently pending invention is readily distinguishable and clearly patentable over the cited reference and the rejection should be withdrawn.

**CLAIM REJECTION UNDER 35 U.S.C. §103**

For the reasons which follow hereinafter, the rejection of claims 1-23 under 35 U.S.C. §103 as being unpatentable over Nakamura et al has been obviated by appropriate amendment and should be withdrawn.

Nakamura et al. teaches a hydrogen storage alloy having a composition of  $Ti_{1-x-z}\alpha_zY_xMn_{y-w}\beta_w$  (see col. 6, lines 44-49). Nakamura also teaches hydrogen storage alloys having the composition  $Ti_{0.9}Zr_{0.1}Mn_{1.7}V_{0.3}$  and  $TiMn_{1.6}V_{0.3}Al_{0.1}$  (see examples 11, 12).

In contrast, the presently pending invention claims a hydrogen storage alloy having the formula  $Ti_{Q-X}Zr_XMn_{Z-Y-W}A_YCr_W$ , wherein A is one or more elements selected from the group consisting of V, Fe, Ni, and Al,  $0.9 \leq Q \leq 1.1$ ,  $0.05 \leq X \leq 0.35$ ,  $0.32 \leq Y \leq 1.8$ ,  $1.8 \leq Z \leq 2.1$ ,  $0.0 \leq W \leq 0.34$ , and  $2.85 \leq Q + Z \leq 3.05$ . Nakamura et al. do not teach an alloy as presently claimed. In particular Nakamura et al. teaches a hydrogen storage alloy including yttrium, whereas the present invention does not include yttrium and excludes its use with the "consisting essentially of" language. The alloys taught in examples 11 and 12 do not fall within the limits of the alloys as presently claimed. The alloy in example 11 when put into the formula of the present invention has a y value of .3 which falls out of the range presently claimed. The alloy in example 12 does not include zirconium, which is included in the hydrogen storage alloy presently claimed. Therefore, Nakamura does not teach any

alloy having compositions overlapping those of the present invention. As such, the presently pending invention claims subject matter neither shown nor obvious over the cited reference and therefore Applicants respectfully request that the pending rejection be withdrawn.

For the reasons which follow hereinafter, the rejection of claims 24-30 under 35 U.S.C. §103 as being unpatentable over Nakamura et al. ('690) or Bernauer et al. or Hydride Database, or Fetcenko et al. ('591) in view of Venkatesan et al. ('486) has been obviated by appropriate amendment and should be withdrawn.

Claims 24-30 depend, directly or indirectly, from independent claim 1, which is now believed to be allowable. As such, the presently pending invention claims subject matter neither shown nor obvious over the cited reference and therefore Applicants respectfully request that the pending rejection be withdrawn.

For the reasons which follow hereinafter, the rejection of claims 1-8 and 23 under 35 U.S.C. §103 as being unpatentable over Fetcenko et al. ('591) has been obviated by appropriate amendment and should be withdrawn.

Fetcenko et al. teaches hydrogen storage alloys for use in Nickel Metal Hydride Batteries (Title). The hydrogen storage alloy include a base alloy containing 0.1 to 60 atomic percent Ti, 0.1 to 40 atomic percent Zr, 0.0 to 60 atomic percent V, 0.1 to 57 atomic percent Ni, and 0.0 to 56 atomic percent Cr. The alloy is then

modified by 12 to 17 atomic percent Mn in the following combinations i) 6.5 to 7.5 atomic percent Co, 13 to 17 atomic percent Mn, and 0.5 to 2.5 atomic percent Fe; ii) 5.5 to 6.5 atomic percent Co, 13.5 to 14.5 atomic percent Mn, 1.5 to 2.5 atomic percent Al, and 0.25 to 1.0 atomic percent Fe; iii) 2.5 to 5.5 atomic percent Co, 14.5 to 15.5 atomic percent Mn, 0.5 to 2.5 atomic percent Fe, and 0.2 to 1.0 atomic percent Zn; and iv) 3.5 to 5.0 atomic percent Co, 14.5 to 15.5 atomic percent Mn, 0.5 to 2.5 atomic percent Fe, and 0.2 to 1.0 atomic percent Sn.

In contrast, the presently pending invention claims a hydrogen storage alloy having the formula  $Ti_{Q-X}Zr_XMn_{Z-Y-W}A_YCr_W$ , wherein A is one or more elements selected from the group consisting of V, Fe, Ni, and Al,  $0.9 \leq Q \leq 1.1$ ,  $0.05 \leq X \leq 0.35$ ,  $0.32 \leq Y \leq 1.8$ ,  $1.8 \leq Z \leq 2.1$ ,  $0.0 \leq W \leq 0.34$ , and  $2.85 \leq Q + Z \leq 3.05$ . Fetcenko et al. ('591) does not teach the alloy as presently claimed. In particular, Fetcenko et al teaches the addition of 12 to 17 percent Mn which falls outside of the range presently claimed. Furthermore, Fetcenko et al. teaches the addition of elements such as Co, Zn, and Sn with Mn. The hydrogen storage alloy as presently claimed excludes such elements as Co, Zn, and Sn with the "consisting essentially of" language contained in Claim 1. As such, the presently pending invention claims subject matter neither shown nor obvious over the cited reference and therefore Applicants respectfully request that the pending rejection be withdrawn.

### OBVIOUSNESS-TYPE DOUBLE PATENTING

The rejection of claims 1-8 based on the judicially created doctrine of obviousness-type double patenting over Fetcenko et al. ('719) has been obviated by appropriate amendment and should be withdrawn.

Fetcenko et al. claims a hydrogen storage alloy including Sn and Co (See claims 1, 12, and 14). The present invention claims a hydrogen storage material consisting essentially of a hydrogen storage alloy having the formula  $Ti_{Q-X}Zr_XMn_{Z-Y-W}A_YCr_W$ , wherein A is one or more elements selected from the group consisting of V, Fe, Ni, and Al,  $0.9 \leq Q \leq 1.1$ ,  $0.05 \leq X \leq 0.35$ ,  $0.32 \leq Y \leq 1.8$ ,  $1.8 \leq Z \leq 2.1$ ,  $0.0 \leq W \leq 0.34$ , and  $2.85 \leq Q + Z \leq 3.05$ . The "consisting essentially of" language excludes the use of elements such as Co or Sn in the present invention. As such, the presently pending invention claims subject matter neither shown nor claimed by the cited reference and therefore Applicants respectfully request that the pending rejection be withdrawn.

The rejection of claims 1-11 based on the judicially created doctrine of obviousness-type double patenting over Ovshinsky et al. ('970) has been obviated by appropriate amendment and should be withdrawn.

Ovshinsky et al. claims a hydrogen storage material comprising 13 to 20 atomic percent chromium (See claim 1). The present invention claims a hydrogen storage material consisting essentially


of a hydrogen storage alloy having the formula  $Ti_{Q-X}Zr_XMn_{Z-Y-W}A_YCr_W$ , wherein A is one or more elements selected from the group consisting of V, Fe, Ni, and Al,  $0.9 \leq Q \leq 1.1$ ,  $0.05 \leq X \leq 0.35$ ,  $0.32 \leq Y \leq 1.8$ ,  $1.8 \leq Z \leq 2.1$ ,  $0.0 \leq W \leq 0.34$ , and  $2.85 \leq Q + Z \leq 3.05$ . The formula as claimed in the present invention allows for an atomic percent of chromium ranging from 0.0 to 10 atomic percent which falls outside the range of 13 to 20 atomic percent as claimed in Ovshinsky et al. As such, the presently pending invention claims subject matter neither shown nor claimed by the cited reference and therefore Applicants respectfully request that the pending rejection be withdrawn.

The rejection of claims 23-33 based on the judicially created doctrine of obviousness-type double patenting over Fetcenko et al. ('719) or Ovshinsky et al. ('970) in view of Venkatesan et al. ('586) has been obviated by appropriate amendment and should be withdrawn. Claims 23-30 depend, directly or indirectly, from independent claim 1, which is now believed to be allowable. As such, the presently pending invention claims subject matter neither shown nor claimed by the cited reference and therefore Applicants respectfully request that the pending rejection be withdrawn.

Accordingly, Applicant submits that the present amendment places the application in condition for allowance. The Examiner is respectfully requested to pass the application to issuance.

The Examiner is respectfully invited to call the Applicants' representative should it be deemed beneficial to further advance prosecution of the application.

Respectfully submitted,



Frederick W. Mau II  
Reg. No 52,453

Date: May 16, 2003  
Energy Conversion Devices, Inc.  
2596 Waterview Drive  
Rochester Hills, MI 48309  
Tel. (248) 293-0440  
Fax. (248) 844-2273  
e-mail: [fmau@ovonic.com](mailto:fmau@ovonic.com)